Arsg priorities and reasoning
Lisa Richardson
to:
Brent Lewis, Kay Zillich, Sabrina Forrest
01/03/2010 10:33 AM
Show Details

Good Morning,

Happy New Year. I hope this finds you well and full and happy. I'm kicking along here after taking way too much time off the last 2 weeks. But it's been fun.

Bill and I have been doing some talking and I hope to do more with him today or tomorrow. Generally speaking, ARSG came to the conclusion some time ago that the Paradise is essentially background up the Ophir drainage because the mine was only punched in about 300 feet there and because the water table is so shallow. Aluminum seems to be particularly high everywhere in the Paradise drainage area. In the same line of thought we also talked about whether Bill agrees with Steve Fearn about the American Tunnel essentially showing background too. He does agree and feels that the Silver Ledge (extremely high Al & Fe loader located up the Colorado Basin drainage) is also basically background. He explained to me why he reasons this but I better not attempt to explain to you. You all need to get that straight from the horse's mouth. I don't understand internal mountain hydrology enough to really get it. But what this discussion does for me is make it plain as day how important it is that we have a better grasp on background, for each drainage. It completely changes how we look at these numbers ARSG gave us and comparing our own data. The ARSG samples were taken 97-98, I believe, and they were taken by members of the group as was the info compiled.

Back to the Paradise, there are some paragraphs about it in the attached document. I did go to the courthouse on Friday to get the ownership information on it and surrounding claims.

Bill did feel it was legitimate to go back since it has been 10 or more years since priorities were set and relook at the line up. And he several times mentioned how nice it is to have Brent involved, how much he appreciates Brent's input. Also, Kay, I've got to give Brent credit for the idea of treatment down at the Bonner creek crossing rather than at the difficult point source. I was only repeating a super idea. But Bill also mentioned that the new foam that Kay spoke about might be a great inexpensive "solution" to look at now.

And do you think there is some ancient bacteria or peat or something below these heavy loaders that can be dissected and dated to tell us whether they really are background? Pre-1800s mining? Should we be putting more of our concentration on that essential part of the equation first?

Happy Sunday reading. It's kinda interesting................
Lisa Richardson
--- On **Sat, 1/2/10, William Simon <*wsimon@frontier.net*>** wrote:

> From: William Simon <wsimon@frontier.net>
> Subject:
> To: "Lisa Richardson" <grenadierglassworks@yahoo.com>
> Date: Saturday, January 2, 2010, 3:32 PM
>
> Lisa, Here is chapter XI of the UAA which contains tables 11.an>1 and 11.2 which are the priority lists. The chapter textexplains how those were determined. Happy New Year! Bill
>
> William Simon

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Please respect my privacy! Do not send this information out to others.

CHAPTER XI - REMEDIATION SCENARIOS

Using the characterization and ranking of sites, the effects of remediating multiple sites can be estimated. This chapter compares several different remediation scenarios including costs. The scenarios help determine what metal loading may be "reversible" versus "irreversible". Natural sources of metals are considered irreversible. Some human-related sources could also be called irreversible if they are very difficult and expensive to change. There is the issue of how cost-effective these changes may be and whether or not they would have a noticeable impact in protecting aquatic life.

MINING-RELATED METAL LOADING

Chapter VIII discusses sources of metals to the Upper Animas Basin. Figures 8.18 to 8.21 show the levels of Al, Cd, Cu, Fe, Mn, and Zn from adits and mine waste. These figures show the maximum amount of each of the six metals that has been identified with mining-related activities. Most remediation methods will remove only a portion of these metal loads.

Chapter X discussed the methodology that was used to rank and prioritize specific adits and mine waste piles in the Basin, and discussed relevant technology that could be used to remediate those sources. Cost estimates and amount of reduction corresponding to different technologies are comparable to the actual remediation costs already encountered by SGC, the ARSG, and others in the Basin. (See Chapter 3, Table 3.1.)

The ARSG technical work group estimated the potential reductions in loading (as a percentage reduction) that could be achieved by implementing remediation technologies at each adit and mine waste site. Estimated loads contributed by each of 174 adits and 158 waste rock sites are shown in Appendix 11A. Of those sites, load reductions, applicable treatment technology, remediation option recommendations and cost estimates have been derived for 78 adits and 127 mine waste sites. Those sites that were not included contributed negligible loading, are a substantial distance from streams, and would not be cost-effective to remediate.

Treatment of adits is divided into two phases. The first phase treatments are generally simpler and lower cost. They would be applied initially and evaluated for effectiveness. The first phase also includes more detailed investigations of complex adits, such as the Paradise portal on the Middle Fork of Mineral Creek. Although costs would be incurred, no improvements would be anticipated for these few specific sites. Phase 2 treatments would be implemented if phase 1 treatments proved partially or completely unsuccessful. These additional treatments are generally more costly but should be more effective in reducing metals.

The estimated cost of remediation of each site is listed as a range in Appendix 11 (and Appendices 10E and 10F). Estimates are based on professional judgement given the technology that could be used and the size and complexity of site. Accessibility affects both cost and the remediation technique selected.

As discussed in Chapter X, the cost analysis is a first approximation and uses four cost categories, each with a broad numerical range. The costs for remediation for each site listed in Table 11.1 below is the mid-point of the range for each cost category. One million dollars was used as an estimate for sites whose costs are greater than $500,000. These cost estimates do not include engineering design, operation, or maintenance costs that may be needed.

Loading from the Largest Adit and Mine Waste Sources

The adits have been ranked, using the weighting factors discussed in Chapter 10, on the basis of both high and low flow loading of seven metals plus pH. Most high flow samples were obtained in June or July, while low flow loads were obtained in September or October. These figures may overestimate low-flow loading since early fall stream flows had not yet dropped to levels seen in winter months. Loads from the Kohler, Bandora, North Star, and Evelyn mines were sampled frequently.

Selection of sites to be included for possible remediation is based upon the combined rankings of all sites within the Upper Basin (Appendix 10E). Many sites were previously categorized as "no action" because of their low total contributions and remoteness and/or low concentrations. The loading from the top ranking 33 adits, including a few large loaders lacking either a high or a low flow sampling datum, are displayed in Table 11.1. These are current loading figures and do not include any potential reductions. Eighty nine percent of the loading from all adits comes from these top 33 sites.

Mine waste piles have been ranked in a similar fashion as adits including the same weighting factors, except that they are ranked by metal concentration determined by the leach test instead of load (Appendix 11A). Table 11.2 lists the top 26 mine waste sites plus an additional six sites which were added because of their large size and therefore potential for significant load contributions. Leachate concentrations presented in Appendix 10E have been converted to "potential loads". The annual load contributed from waste rock site in Table 11.2 was estimated by multiplying the concentration from the leach test of the waste rock times the surface area of the pile times the average annual runoff from the basin expressed as depth (29 inches). The potential load figures do not include any potential reductions.

The 32 waste sites listed contribute 90% of the estimated load from all 158 sites. Units are in pounds per year as opposed to pounds per day used for adits. Estimated loading from mine waste is much smaller than from adits. Approximately eighty-five percent of the mine-related annual metal load in the Upper Animas Basin is from adits, and fifteen percent is from mine waste.

As with adits, the appropriate site treatment and corresponding load reductions are based on professional judgement. Again, the estimated costs of remediation fall into the same four categories used for adits. The costs listed in Table 11.2 are the mid-point of the ranges of each category applied to the particular site.

Sites with CPDES or reclamation permits are not included in the tables in this chapter. It is assumed that required best management practices and/or treatment at these sites is already in place.

Table 11.1 Metal loads from selected adits in the Upper Animas Basin

			Pounds per day											
			High Flow						Low Flow					
Mine	**Phase 1 % Removal**	**Cost $ 1000's**	**Al**	**Cd**	**Cu**	**Fe**	**Mn**	**Zn**	**Al**	**Cd**	**Cu**	**Fe**	**Mn**	**Zn**
Cement Creek														
Mogul	80%	1000	1	0.04	1.7	14	4	2	1	0.02	0.7	5	1	3
Silver Ledge	50%	300	25	0.09	0.6	222	33	15	4	0.03	0.0	56	11	3
Grand Mogul	0%	60	15	0.15	5.3	33	10	27	1	0.01	0.2	0	0	1
Mammoth	30%	60	1	0.00	0.0	14	2	8	1	0.00	0.0	16	2	0
Anglo-Saxon	30%	60	0	0.00	0.0	15	10	2	0	0.01	0.0	15	5	1
Joe & Johns	30%	300	0	0.00	0.2	1	1	1	0	0.00	0.0	1	0	0
Big Colorado	50%	300	1	0.00	0.0	3	3	0	1	0.00	0.0	6	0	0
Porcupine	30%	60	0	0.00	0.0	14	5	1	0	0.00	0.0	10	5	1
Evelyn	50%	1000	1	0.00	0.0	2	0	0	2	0.00	0.0	3	0	0
Lewis property	50%	60	0	0.01	0.4	2	0	1	0	0.01	0.4	2	0	1
Total Cement Creek			44	0.29	8.3	320	68	57	10	0.07	1.3	113	25	12
Mineral Creek														
Kohler	50%	60	33	0.36	30.7	321	10	91	28	0.25	28.3	264	8	78
North Star	50%	300	0	0.02	0.1	6	16	4	1	0.02	0.2	6	11	3
Junction Mine	50%	300	13	0.07	2.2	126	3	14	0	0.00	0.1	3	0	0
Bandora Mine	30%	60	0	0.04	0.1	5	4	10	0	0.02	0.0	2	2	4
Upper Bonner	50%	300	1	0.00	0.0	1	1	1	2	0.01	0.0	2	1	1
Ferrocrete Mine	50%	300	2	0.00	0.0	31	5	1	3	0.01	0.0	32	7	1
Paradise	0%	60	28	0.00	0.1	246	20	2	28	0.00	0.1	246	20	2
Brooklyn Mine	30%	300	1	0.01	0.2	8	2	2	1	0.01	0.2	8	2	2
Bonner Mine	50%	300	1	0.01	0.0	1	1	1	2	0.00	0.0	2	1	0
Lower Bonner	30%	300	1	0.00	0.0	1	0	0	2	0.00	0.0	2	1	1
Little Dora	50%	300	1	0.33	0.9	5	653	48	0	0.00	0.0	0	2	0
Total Mineral Creek			81	0.85	34.3	751	715	175	65	0.31	28.9	566	54	93
Animas above Eureka														
Vermillion Mine	50%	300	0	0.04	0.2	2	1	9	0	0.01	0.1	1	0	3
Columbus	50%	300	1	0.01	0.3	3	0	9	0	0.02	0.1	1	0	4
Lower Comet	0%	10	2	0.00	0.1	2	2	1	2	0.00	0.0	1	1	1
N side of Calif. Mtn.	30%	60	4	0.01	0.0	1	5	2	4	0.01	0.0	1	5	2
Sound Democrate	50%	60	0	0.00	0.1	0	4	1	0	0.00	0.0	0	2	0
Mountain Queen	50%	300	0	0.00	0.2	1	0	1	0	0.00	0.1	0	0	0
Silver Wing	30%	0	0	0.00	0.1	0	0	0	0	0.00	0.3	1	1	1
Bagley	30%	300	0	0.01	0.0	0	13	7	0	0.01	0.0	0	6	3
Senator	30%	300	0	0.00	0.0	21	7	0	1	0.00	0.0	23	14	2
Total Animas above Eureka			8	0.08	1.0	30	33	29	8	0.06	0.7	29	29	15
Animas below Eureka														
Royal Tiger	50%	300	5	0.04	0.8	0	3	7	0	0.00	0.1	0	0	0
Pride of the West	30%	60	0	0.01	0.0	0	0	3	0	0.01	0.0	0	0	2
Little Nation	30%	300	0	0.00	0.0	9	2	1	0	0.00	0.0	4	1	0
Total Animas below Eureka			6	0.06	0.8	9	5	10	0	0.02	0.1	4	2	3
Grand Total			138	1.29	44.5	1110	822	271	83	0.45	31.0	712	109	124

- **No low flow data. Low flow loads are extrapolated from high flow data**

** **No high flow data. High flow loads are extrapolated from low flow data**

Table 11.2 Metal loads from selected mine waste rock sites in the Upper Animas Basin

Site Name	Acres	% Reduction	Cost $1000	Al	Cd	Cu	Fe	Mn	Zn
				Load in pounds per year					
Cement Creek									
Galena Queen	1.09	90	300	154	36.8	832	6,895	0.0	6137
Kansas City #2	0.46	40	60	159	7.1	39	3,979	0.0	1172
Hercules	1.26	90	300	163	30.6	168	6,712	0.0	4711
Upper Joe & Johns	0.02	40	300	2	0.1	2	19	0.0	23
Grand Mogul - East	0.53	35	300	47	2.0	29	745	0.0	385
Kansas City #1	0.48	40	60	82	1.2	19	1,618	0.2	282
Black Hawk	0.20	50	60	82	0.5	6	124	0.1	108
Lead Carbonate	0.62	55	300	120	0.8	27	1,228	0.0	179
Henrietta 3	0.86	20	60	217	0.7	107	4,972	0.0	113
Ross Basin	0.15	10	60	9	0.3	18	234	0.0	49
Lark	0.66	90	60	18	0.8	40	886	0.0	168
Pride of the Rockies	0.05	45	60	7	0.1	0	383	0.1	7
Henrietta # 7	1.19	40	300	101	0.8	25	1,685	0.0	159
Mogul	1.16	35	300	51	1.2	32	942	0.0	261
Cement Creek Total	8.72			1,210	83.1	1,343	30,421	0.5	13,754
Mineral Creek									
Brooklyn	0.25	90	300	58	0.8	8	993	117	118
Bullion King:Lower	0.86	90	300	641	6.0	14	9,945	190	629
Upper Browns Trench	0.11	40	10	27	0.1	8	198	3	9
Congress Shaft	0.35	40	60	11	0.2	16	109	11	20
Brooklyn Upper	2.57	20	60	661	3.1	38	9,909	176	163
Upper Browns	0.51	90	60	82	0.3	5	1,610	6	25
Little Dora	1.39	30	300	94	0.4	43	452	471	66
Brooklyn Lower	0.86	20	60	110	0.6	9	672	122	105
Mineral Creek Total	7			1,684	11.5	142	23,888	1,095	1,135
Animas above Eureka									
Ben Butler	0.34	40	300	28	0.8	8	225	1	165
Silver Wing	1.21	50	60	98	1.0	123	393	172	131
Tom Moore	0.19	90	60	15	0.3	1	8	43	73
Eagle	0.07	90	60	1	0.1	1	0	7	18
Lucky Jack	0.70	90	60	16	0.6	3	14	32	95
Animas above Eureka Total	3			157	2.8	136	639	256	482
Animas below Eureka									
Clipper	0.09	90	60	6	0.2	7	80	57	70
Buffalo Boy	0.38	90	60	17	0.8	24	13	73	141
Ben Franklin	0.37	90	60	81	0.4	13	612	99	95
Caledonia	0.57	30	60	23	1.0	15	1	50	255
Sunnyside	2.50	90	1,000	40	2.3	10	0	536	664
Animas below Eureka Total	4			168	4.6	69	706	815	1,224
GRAND TOTAL	22			3,219	102	1,691	55,655	2,167	16,595

METAL REDUCTION SCENARIOS

Using the information from Tables 11.1 and 11.2 and Appendix 11A, the results of several different remediation scenarios can be estimated. The scenarios shown on Table 11.3 include phase 1 treatment of the top 33 adits and of the top 78 adits, phase 2 treatment of the top 33 adits and of the top 78 adits, phase 1 treatment of the top 32 mine waste piles and of the top 127 mine waste piles. Costs listed under phase 2 include the costs of both phase 1 and phase 2 treatments since phase 2 would not be implemented until after phase 1 had been tried.

For the adit scenarios, loading figures are derived from low-flow samples because that time period is of most concern. Out of 174 adits sampled, only 133 had measurable drainage during low-flow samplings.

The cost estimates listed on the tables above and in Appendix 11A do not include engineering design, operation, or maintenance costs. Remediation experience in the Basin has shown that administration costs are substantial and cost overruns have been encountered owing to larger than expected volumes of material or other unanticipated problems. The scenarios listed below include a 30% administration cost and a 20% contingency cost added to the sum of the individual site costs.

Table 11.3 Summary of metal loads from adits and combined mine waste for the Animas Basin above A72.

	Adits Low flow loads		Mine Waste	
	Total load of Al, Cd, Cu, Fe, Mn and Zn in pounds/year			
Top 33	386,741		Top 32	79,429
173 Adits[1]	434,547		Top 158	88,602
	Estimated cost to remediate in $1000's			
	Phase 1	Phase 2		Option 1
Top 33	$ 12,105	$ 20,550	Top 32	$ 8,175
Top 77	$ 20,550	$ 31,830	Top 127	$ 21,960
	Load Removed in pounds/year			
	Phase 1	Phase 2		Option 1
Top 33	128,041	194,275	Top 32	50,494
Top 77	138,834	208,945	Top 127	54,618
	Cost pound/year			
	Phase 1	Phase 2		Option 1
Top 33	$ 94.54	$ 105.78	Top 32	$ 161.90
77 Adits	$148.01	$152.34	Top 127	$ 402.10

*Total cost divided by load removed.

[1] Revised 7/15/01 from 133 adits

Clearly there are diminishing returns in treating both adits and mine waste. The top 33 adits account for 89% of the load and under phase 1, it would cost $12.5 illion to treat them. To treat the additional 11% of the load would add $8.5 million. The contrast is more stark under mine waste. The top 32 sites account for 90% of the load and would cost just over $8 million to treat. Treating the additional 10% would add almost $14 million.

The phase 2 adit scenario includes removal of large quantities of Fe and Al from the Paradise portal. In fact, 81% of the difference in load removed between phase 1 and phase 2 for adits can be attributed to phase 2 remediation of the Paradise alone. Under phase 1, no reductions in metals from the Paradise are anticipated because a more thorough investigation of the site will be the first step. With the exception of this one site, there is little difference in reductions of metals between phase 1 and phase 2. Moreover phase 2 would only be implemented if phase 1 did not result in projected reductions. Therefore, without the Paradise and its associated phase 2 remediation cost of $1 million, the difference in costs between phase 1 and 2 can be thought of as a range of costs associated with a total loading reduction for adits of approximately 170,000 to 180,000 pounds per year.

Remediating the Paradise portal and another site, the Ferrocrete mine. is problematic. They are both shallow workings in the Mineral Creek drainage and lie near the base of valleys. The mines are thought to have intersected the relatively shallow groundwater that wells up at valley bottoms creating the area's infamous iron seeps and bogs. Metal loading may well be the result of natural geological processes that is carried <u>into</u> the mine through groundwater infiltration. While treating naturally occurring source loads (coming from adits) may be beneficial, discharges with high iron and aluminum concentrations are expensive to treat because of high production of sludge which needs disposal plus frequent system maintenance. These adits are also collapsed, indicating that they were constructed in highly fractured rock making it unlikely that bulkhead seals would provide significant reductions. Successful remediation of these sites would be very difficult and expensive.

EFFECTS OF REMEDIATION ON WATER QUALITY

Figure 11.1 shows the estimated reductions of the six priority metals at the four gages if remediations were implemented on the top 32 mine waste piles and phase 1 remediations were implemented on the top 33 adits. Figure 11.2 shows estimated reductions if remediation were implemented on the top 32 mine waste piles and phase 2 remediations were implemented on the top 33 adits. The description below summarizes the results.

Animas above Silverton, A68

Remediation of combined mine waste and either the phase 1 or phase 2 adit scenarios will have very little effect on reducing the concentration of Al, Cd, Cu, Fe, Mn, or Zn at A68. Cd and Mn will continue to exceed chronic TVS under the average streamflow condition in the late winter and early spring. Zn will continue to exceed both acute and chronic TVS year-a-round. Cu, when corrected for the dissolved fraction, should meet TVS. Al and Fe meet aquatic life TVS criteria.

A substantial amount of Cd, Mn, and Zn enters the Animas River from unidentified, diffuse sources between Arrastra Gulch and A68. The largest tailings piles (previously ponds) in the Basin lie near the river along this stretch. The site is permitted and has undergone extensive remediation work over the past ten years. In the fall of 1999, a trench was dug to bedrock above the tailings, and a barrier and drainage system was installed to capture groundwater flow that might enter the piles. Data collected after 1999 was not used for the UAA. Therefore, the impacts of the most recent remediation work are unknown. In addition, it is doubtful that one year's data would be enough to identify changes in water quality due to these actions. Given the minimal remediation potential identified upstream, an evaluation of the "reversibility" of the load of Cd, Mn, and Zn that enters the Animas River between Arrastra Gulch and A68 will be needed to determine if water quality can be substantially improved at A68.

Cement Creek at Silverton, CC48

Remediation of combined mine waste and the phase 1 adit scenario should reduce levels of Cd, Cu, and Zn below levels encountered in Cement Creek before SGC began treatment of upper Cement Creek at the AT plant. Implementation of the phase 2 scenario in Cement Creek will have only a small beneficial effect beyond phase 1 on the concentration of Cd, Cu, and Zn at CC48, unless phase 1 is significantly unsuccessful. Figures 11.1d and 11.1e indicate that either the phase 1 or phase 2 remediation scenario will have little effect on levels of Fe or Mn. Remediation will have no effect on the level of Al. Concentrations of all six metals will remain above both acute and chronic TVS for aquatic life.

Mineral Creek near Silverton, M34

Remediation of combined mine waste and the phase 1 adit scenario should reduce levels of Cd, Cu, and Zn to concentrations that meet chronic TVS during average stream flow. The current level of Mn is less than TVS for aquatic life. Implementation of phase 1 reductions should lower the level of total recoverable Fe, however it will continue to exceed aquatic life TVS year-a-round. This analysis shows that remediation is not expected to measurably change the concentration of dissolved recoverable Al, which will continue to exceed acute TVS criterion during the winter. Implementation of phase 2 reductions will primarily lower levels of total recoverable Fe, however, Fe will continue to be higher than TVS for aquatic life.

Animas River below Silverton, A72

Remediation of the combined mine waste and the phase 1 adit scenario should reduce levels of Cd, Cu, and Zn during average stream flow. Cd and Cu concentrations will be close to chronic TVS for aquatic life but may exceed those criteria in the spring. Zn will continue to be at a level that exceeds both acute and chronic TVS for aquatic life year-a-round. Fe and Mn concentrations may be slightly lower, however, total recoverable Fe will continue to exceed TVS year-a-round. Mn currently is lower than the TVS. Neither phase 1 nor phase 2 remediation is expected to have much effect on the current level of dissolved Al. Aluminum would continue to be a limiting factor. If a sufficient amount of the load of Cd, Mn, and Zn that enters the Animas River between Arrastra Gulch and A68 can be "reversed," further improvements in those constituents should be seen at A72.

Reductions in pH

Current TVS for pH is 6.5 to 9.0. pH is a measurement of hydrogen ions based on a logarithmic scale (base 10) so that a whole number increase, from 5.0 to 6.0 for example, signifies a ninety percent reduction in the concentration of hydrogen ions. The presence of iron is a major factor in determining pH.

In winter, pH is 6.1, 5.5, and 4.8 for segments 3a, 4a, and 9b respectively. Attempts were made to model potential improvements in pH due to remediation, but they were unsuccessful. Because of the low potential reductions identified for iron above A68, it is uncertain if pH may be improved. The possibility of improving pH is higher at M34 and A72, because of the potential for reductions in iron loading, but the amount of improvement is probably quite small. Reaching the TVS standard is highly unlikely.

APPENDIX 11A

REMEDIATION SCENARIO WORKSHEETS

1. ADITS
2. MINE WASTES

This information is available on the CD-ROM only